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**The Physical Features of the Environs of  
Kingston, Ont., and their History.**

**By A. T. DRUMMOND.**

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## **The Physical Features of the Environs of Kingston, Ont., and their History.**

BY A. T. DRUMMOND.

Two years ago, when revisiting for three months the scenes of my earlier years at Kingston, the opportunity occurred again of examining, hammer in hand, the Laurentian ridges, the limestone escarpments, and the picturesque islands which contribute so much to the variety of the landscape in the neighbourhood of the city, as well as make its environs so geologically interesting. When a student at Queen's, I had gone over the ground, occasionally with Dr. Geo. Lawson, now of Dalhousie College, Halifax, but then of Queen's, sometimes with the late Dr. John Beil, of Montreal, who was an enthusiastic botanist, and often, alone, and as the familiar spots, one after another, came, after long years of absence, once more to view, many a pleasant memory of extended rambles and of interesting discoveries was recalled. The geological notes then made when a student have not been published, but some of them are still of interest and will be referred to here and be supplemented by the more recent notes.

Lying almost at the point of contact of the old Archæan rocks with those of the overlying Cambrian and Trenton, and in a section of country where the evidences of glacial action in quaternary times are very marked, besides being at the foot of Lake Ontario where the waters of the Great Lakes join the St. Lawrence amid the diversified features and scenery of the Thousand Islands, Kingston has much to interest the geologist. The city itself is, in reality, situated on what appears to have been an ancient island, whose length was about six miles with an extreme breadth

of three miles, and whose boundaries, apart from the harbour front, are now well defined by the limestone escarpment, which, leaving the lake shore west of the Lunatic Asylum, skirts the broad valley of Little Cataraqui Creek some miles in a northerly and then north-easterly direction, until, veering around to the south-east as it approaches Kingston Mills, it meets Great Cataraqui Creek and then parallels it in its entry to the harbour at Kingston.

The harbour fronting Kingston is, in its main expanse, underlaid, probably throughout, by the Black River limestones, judging by the comparative uniformity of the soundings in the channel. The usual depth there is from ten to twelve fathoms. Off Cedar Island the bottom may have suffered by the disturbances which affected the whole Laurentian area, as I have found there the greatest depth of the harbour—seventeen fathoms.

The precise area occupied by the palæozoic rocks in the environs of the city, and their age, have not hitherto been as accurately defined as is desirable, and a brief reference to these and the Laurentian rocks is necessary.

#### LAURENTIAN ROCKS.

The Laurentian rocks are met with in great masses at Kingston Mills, and thence eastward and north-westward, forming here and among the Thousand Islands the gneissic ridge, as it were, which connects the Laurentian areas of New York State with those of Canada. Nearer Kingston, these rocks appear on the summit of the Fort hill, on the banks of Haldimand Cove, and on Cedar and Milton Islands, in each case forming ridges which—as elsewhere among the Thousand Islands—lie in a general north-east and south-west direction. The Laurentian strata have been here elevated into these great ridges at a period subsequent to Black River times, as, on the Fort hill, the limestone strata are tilted up at a high angle on both sides of the steep ascent, and overlies the Laurentian from the base to

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almost the summit, which is crested with gneiss.<sup>1</sup> On the north side of Cedar Island the limestone strata are also seen near the water's edge in a similar but less tilted position. Again, there are not wanting some indications, near the granite quarries on the banks of Haldimand Cove, that the granitic rocks here are not earlier in age than the Black River, and are probably contemporaneous with the upheaval of the Laurentian strata.

POTSDAM SANDSTONE.

On the banks of the Rideau Canal the Potsdam sandstone is first met with about five or six miles to the eastward of Kingston Mills, and is here of suitable quality and in ample quantity for building stone. On the south side of Pittsburg, opposite Howe Island in the St. Lawrence between Kingston and Gananoque, and again at the lower end of that island, it is once more seen, whilst at Gananoque it forms the eastern bank of the ravine near the village and both banks of the river Gananoque immediately in the village. Judging from the soundings made by me, it, likewise, forms the bed of this stream and extends outwards some distance under the St. Lawrence. The stone is used with very good effect in Gananoque for building purposes. Hay Island, Tidds Island, part of Round Island, and the upper end of Wellesly Island at the Thousand Island Park, also belong to this formation. There are thus exposures of the Potsdam sandstone at intervals to within six miles of Alexandria Bay, and as the same rock reappears near there and continues again at intervals to Brockville, there is a

<sup>1</sup> My friend, Mr. Frank D. Adams, informs me that at Lake St. John limestone rocks of lower Silurian age, with similar dips at their immediate contact with the sloping gneiss floor on which they were deposited, have been found by the Geological Survey officers in reality in their natural beds as deposited, the material having apparently rolled off, as it were, from the apex and lower down, and adjusted itself in sloping beds on the sides. In this instance at Kingston, however, the evidence of upheaval is distinct, and I am glad, since this paper has been put into type, to have the corroboration of so careful an observer as Prof. James Fowler, of Queen's University, Kingston, who writes that "the breaks in the strata and the dip towards the bridge on the one side and the river on the other, look as if the elevation took place after the Black River was laid down."

probability that in earlier times it has had a very much more extensive development in the valley of the St. Lawrence here, possibly, originally, bridging over the present Laurentian break.

#### BLACK RIVER ROCKS.

The city of Kingston itself is underlaid by the Black River limestones, these in turn resting directly on the Laurentian strata, as is well illustrated on the Fort hill, Cedar Island, the banks of Haldimand Cove and elsewhere. These Black River strata, underlying and around the city, are somewhat deficient in fossils, and at the time of publication of Sir William Logan's General Report on the Geology of Canada in 1863, considerable doubt was entertained as to whether these rocks, in, at least, their lower portion, might not belong to an earlier epoch. My own subsequent finding, however, of *Orthoceras rapax*, Bill, and some fragments of crinoidal columns in a deposit of somewhat disintegrated rock containing numerous silicified fragments of fossils and directly reposing on the Laurentian in a cutting of the Grand Trunk Railway at Kingston Mills, finally determined the late Mr. E. Billings, the paleontologist of the Geological Survey, to refer the strata to the Black River age. Those strata which rest directly on the Laurentian are generally, however, quite devoid of fossils, and not infrequently the lower layers have the appearance of a conglomerate, the imbedded material being small worn boulders of gneiss and quartzite from three inches to one foot in diameter, and numerous sharply angular pieces of quartz, chiefly of smaller size. On the north side of the Grand Trunk Railway track the limestones terminate west of Kingston Mills, but on the south side they extend in a partly covered escarpment about five miles farther eastward, and cover the intervening space thence to the St. Lawrence. Garden Island, and the greater portion of Howe, Wolfe, and, possibly, Simcoe Islands, are of Black River age.

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TRENTON ROCKS.

At Cape Vincent, in New York State, opposite Wolfe Island, the limestones contain, amongst other life, *Calymene Blumenbachii*, Bron, and *Leptæna sericea*, Sow, which sufficiently indicate their Trenton origin. At Horse Shoe Island, at the head of Wolfe Island, about eight miles southwest of Kingston, and again at Collinsby, on the Grand Trunk Railway, the rocks apparently belong to the same epoch. Thus, if any actual distinction is to be retained in Canada between the Black River and Trenton epochs, a line drawn across the St. Lawrence through these localities would appear to about indicate where the Black River rocks are succeeded by the true Trenton.

QUATERNARY DEPOSITS.

From the period of the Trenton to that of the Quaternary, the environs of Kingston appear to have had a long rest from the inroads of the water and from other disturbing influences, beyond the special elevation of the Laurentian ridges before referred to, and the general elevation of the whole country here and to the north-eastward, to admit of the necessary fall for the great glaciers of the glacial period. The traces left by quaternary forces are seen in the limestone escarpments at many points in the environs of the city; the broad river valleys now occupied by Little Cataraqui and Great Cataraqui Creeks; the ice grooves, visible in every direction, but developed on a magnificent scale, near the upper steamboat landing on Wolfe Island; the great deposits of sand at Cataraqui and elsewhere; and the Laurentian and other boulders scattered everywhere, even on the top of the Fort Hill, where the huge block of unworn Potsdam sandstone, half buried in the soil, is a conspicuous object.

Whilst the history of the site of the city and its environs during the vast ages which elapsed between the Trenton period and the close of the Tertiary, is almost a blank, yet, from the latter time, its history begins once more. Suggestions of great forces having been at work come, as we

have seen, from all sides—from the lake bottom, the river valleys, the grooved rocks, the great stretches of escarpments, the scattered boulders. At the close of the Pliocene the Laurentian area in the townships to the northward and eastward was higher than it presently is, and circumstances seem to show that this elevation extended so far over the limestone area in the vicinity of Kingston that the lake shore at that time was probably outside of a line drawn from Stony Point, off Sacket's Harbour, to South Bay Point, in Prince Edward County. A rise of 100 feet would bring to the surface nearly the entire area presently under water between this limiting line and the city—excepting what would then form two inlets or river channels—the relicts, it may be, of two glaciers—the one on the west side of Duck Island and extending inwards towards Kingston to within three miles of the present Nine-mile Point Lighthouse, and the other on the east side of the same island and extending in the direction of the present American channel in the St. Lawrence, and to within four miles of the south-west point of Wolfe's Island.

#### LAURENTIAN RIDGES.

At this time, also, the Laurentian ridges, which are so numerous in the rear townships, and are illustrated around Kingston in the elevations comprising Cedar Island, the Fort Hill, and the south side of Haldimand Cove, had already appeared. These ridges which in reality indicate, in their prevailing general north-east and south-west course, the direction taken by the vast internal forces which gave rise to their upheaval, have had much to do with giving the direction taken by the great glaciers of quaternary times, and have also shaped the original outline of many of the numerous lakes in the Laurentian country in the immediate rear of Kingston, however much the glaciers may have subsequently smoothed the roughness of this outline. The general course of the numerous elongated lakes lying here in the laps of these ridges, and near the border-land where the Laurentian and the higher formations meet, is a

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most pronounced north east and south-west, and I cannot think that their outline is to be attributed solely to softer strata having been worn away. It was rather that the ridges and intervening valleys gave the course to the glaciers, and, in that course, these valleys had their outlines smoothed and their depths somewhat deepened, and were thus prepared for their new position as the beds of lakes in the less elevated country of the present day. The lie of the lakes, in sections of the Laurentian country farther west, takes different directions—sometimes to the south-eastward and across the general line of glacial action—and it will, I suspect, be found, in such cases, that this lie of these lakes conforms to that of the ridges in the surrounding country.

#### ORIGIN OF THE ISLAND.

Following the elevation of the land and the incoming of the glacial period, came probably the first outlining of the ancient island on which Kingston is situated. The present broad beds of Little Cataraqui and Great Cataraqui Creeks were gradually chiselled out, first by glaciers and then by the waters of what would then be two deep inlets from the lake and a river divided by the island, and thus the limestone escarpment which in large part forms the island's front was created. The sand deposits in the direction of Glenburnie, again at Cataraqui, and again in the estuary west of the Lunatic Asylum, would seem to indicate that the Little Cataraqui Creek valley was the channel down which the great body of the water from the Laurentian heights immediately beyond here came. The different beds of sand in the estuary also appear to mark three successive stages and conditions of deposit—the lowest, a coarse sand laid down in deeper water, the middle a strongly wave-marked bed, indicative of rapidly flowing waters, and the highest a deposit of fine silt-like sand, which has settled during comparatively still waters.

#### THE OUTLET OF LAKE ONTARIO.

Perhaps the most interesting questions are connected

with the outlet of the waters of Lake Ontario into the St. Lawrence here. Have these waters since Ontario expanded from a river into a lake always flowed downwards to the ocean over the Laurentian ridge at the Thousand Islands? Presently there is a depression here between the Adirondacks of New York State and our Canadian Laurentian ridges sufficient to admit of this downward flow, but, between Kingston and Cape Vincent, it is a comparatively shallow depression. The lake is undoubtedly pre-glacial, but the somewhat higher elevation of the Laurentian area at the close of the Pliocene to admit of the descent of the glaciers, would make it probable that at this time, as well as during the melting and recession northward of the ice area, the outflow was by way of Lake Oneida and the Mohawk Valley. Even at the Park towards the centre of the Thousand Islands, the grooves in the sandstones lie S. 40° W., showing that there must have been some elevation in the heart of the Laurentian ridge there to admit of the necessary ice flow, not merely there but onwards to the south-westward over the ice-grooved limestones at Kingston and Wolfe Island. During the glacial epoch, and its interglacial periods, if any, here, the outlet was, the American geologists insist, so completely blocked with ice that the flow was necessarily by way of the Mohawk Valley to the ocean, but it does not seem requisite to assume that there was this ice blockade, as the already existing elevation probably formed a more than ample barrier to the lake waters.

If this view of Laurentian depression be correct, then the St. Lawrence, immediately before the commencement of the ice age, was a modest stream, taking its rise here in the Adirondacks or Canadian Laurentians and flowing towards the sea in very much the same course as now, for this course was not much altered by the subsequent ice flow north-eastward from the Laurentians. The river from Brockville, immediately above which the Laurentian ridges under the river disappear, downwards to the first rapid near Edwardsburg, has, on the whole, a considerable uniformity

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of depth in the channel, and flows through a low, comparatively level valley, unobstructed by islands. The river Ottawa, on the other hand, was, probably, at this time a much larger stream, as the great limestone escarpments and the terraces along its course seem to indicate. The oscillations of the earth's surface in eastern Ontario and in Quebec had led to its being at one time an arm of the sea, and at another, perhaps later time, a great river, which Mr. J. K. Gilbert even thinks found its rise in the Georgian Bay and drained the upper Great Lakes. During the ice age, and the subsequent Champlain times, the path of the icebergs and glaciers was, in a general sense, down the valley of the Ottawa, and this, no doubt, occasioned much of the wear of the strata in the river's course.

The oscillations in level over great stretches of country or local warpings of the strata, will explain many of the physical features of a district. Thus, around the outlet of Lake Ontario there were changes of this character. A depression at the Thousand Islands, and a rise in level at the south-eastern end of Lake Ontario, led to a gradual change in the lake's outflow from the valley of the Mohawk to the valley of the St. Lawrence. This change took place in the Champlain era, and was probably contemporaneous with that condition of depression in Eastern Ontario and Quebec and that condition of flood and depression in the peninsula of Ontario west of the Thousand Islands, which has given us the sands and clays of the one section and the great areas of the clays in the other. Since then there have been further warpings of the surface, involving a rise from the Trent Valley westward and on the south and east sides of Lake Ontario. These disturbances have, in general terms, brought us to the order of things at the present day.